Reed Canary Grass (Phalaris arundinacea) Management Guide:
Recommendations for Landowners and Restoration Professionals

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For more information on reed canary-grass, please contact:
National Invasive Species Information Center, http://www.invasivespeciesinfo.gov
Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Invasive Plant Fact Sheet, http://www.dnr.state.oh.us/dnap/invasive/6canarygrass.htm
USDA - NRCS PLANTS Database, http://plants.usda.gov/
USDA - NCCS, http://www.myspecies.info/
USDA - WPS, http://www.naturalwetlands.org
How to use this manual?

This guide walks you through the steps you can take to manage reed canary grass. Please start at the beginning and see TABLE 1 for a summary of treatment options that can be used. TABLE 2 will help you conduct a site assessment and decide which techniques are best suited to your budget and situation, and TABLE 3 lists native species that may provide competition for reed canary grass during restoration and management efforts.

Reed canary grass (hereafter RCG) is a threat to the ecological integrity of countless wetlands across Wisconsin. Bernthal and Hatch (2008) found that 1 in 7 wetland acres in their southern and south-central Wisconsin study area were heavily dominated or co-dominated by RCG, and approximately 500,000 acres of wetlands in the entire state are infested. Reversing this pattern will require a large-scale, long-term, cooperative effort from scientists, policy makers, agency professionals, contractors, and non-profit organizations. It will also require cooperation from landowners. Consider taking an active role in the stewardship of our natural heritage through your actions to reduce RCG and promote native biodiversity in Wisconsin's wetlands!

This Reed Canary Grass Management Guide provides a template for local-scale RCG abatement, and it summarizes our current understanding of invasion biology and management tactics for RCG. It is our intention to periodically update this information as new results from ongoing research contributes to our understanding of this species.

What is the impact of RCG?

The impacts of reed canary grass on the habitats it invades are many. RCG greatly reduces botanical and biological diversity by homogenizing habitat structure and environmental variability (both of which correlate with species richness), alters hydrology by trapping silt and constricting waterways, and limits tree regeneration in riparian forests by shading and crowding out seedlings. RCG also decreases retention time of nutrients and carbon stored in wetlands, accelerating turnover cycles and reducing the carbon sequestration capabilities characteristic of diverse plant communities. Although its effects on wildlife are not yet entirely clear, preliminary data suggest that habitat specialist species (including several listed and protected species) are more adversely affected by reed canary grass dominance than habitat generalists.

Introduction

Reed canary grass is an aggressive, cool-season RCG is an aggressive, cool-season perennial grass that invades and dominates a variety of wetland types. Invasion typically occurs after disturbance from erosion, sedimentation, nutrient enrichment, road salt inflows, hydrological instability or modification, and restoration efforts that expose bare ground and increase high light availability. RCG responds positively to nutrient inputs, either as fertilizer or nonpoint agricultural runoff. Recently, it was discovered that the presence of multiple disturbances, characteristic of many of Wisconsin's wetlands, can interact to accelerate the pace of invasion and native species displacement. Because of its vigorous growth in wet soils, RCG has been intentionally planted since the early 1900's by livestock producers for forage and seed production, and it has been used for erosion control and soil stabilization.

RCG reproduces by seed, by stem fragments, and by underground horizontal stems (rhizomes). Field populations have a high degree of genetic variability, and it has been estimated that more than 115 artificially-selected reed canary grass genotypes have been developed. There is no rapid way to determine the genetic origin of a particular RCG stand, although the presence of green or purple panicles (grass flowers) in mid-June point to the existence of different genotypes within the stand. This species is both drought and flood tolerant. Growth and productivity peak twice during the growing season, first in late spring and again in late summer. These growth peaks are under separate genetic control, with leaf and inflorescence growth dominating in the spring and stem and rhizome growth dominating during the late summer peak.

Reed canary grass is one of the first wetland plants to emerge in the spring, enabling it to shade out native species that emerge later in the growing season. RCG can stay continued

LIFE CYCLE OF REED CANARY GRASS

RCG in Flower Reed canary grass monotype(s)
Reed Canary Grass Life History continued
green and actively growing well past the first killing frost in autumn. Once established, RCG is capable of rapid clonal expansion, which is enhanced by high nutrient and light availability. Species with clonal growth mechanisms expand either by employing a phalanx strategy, where tillers mass into an impenetrable clone expanding over short distances, or a guerilla strategy, where the parent plant forms long rhizomes and new tillers emerge at a distance from the parent clone. RCG uses both the phalanx and guerilla strategies. It more typically spreads by vegetative shoots arising from shallow rhizomes which can extend over 10 feet per year and form a thick impenetrable mat below the soil surface. These rhizomes have numerous dormant buds that represent the primary mechanism for resurgence when above-ground growth is removed. Rapid expansion, early growth, and the mulching effect of a dense litter layer all interact to facilitate the decline of native species. Few native species can persist indefinitely within a dense clone of RCG. To make matters worse, seeds and vegetative fragments readily float, making streams and ditch networks effective dispersal corridors, especially during periods of flooding. RCG seed is also dispersed by humans and wildlife, as the seed adheres readily to moist skin or fur, and is transported in clothing, equipment, and vehicles.

For a RCG seed to germinate, or for a vegetative fragment to become rooted, a disturbance that creates a bare space is initially required. Seed germination is bimodal, peaking in March-May and again in June-July. Seedlings are vulnerable to management treatments and inter-specific competition until they become well-established. New seedlings allocate most of their growth to accumulating underground reserves and developing tillers during the first growing season, generally only needing a single growing season to become established. Once established, RCG emerges in the spring from rhizome reserves accumulated during the previous growing season. By using both new energy from photosynthesis and reserve energy from rhizomes for spring growth, RCG quickly towers over most other species, preempting all available space and light. Since most spring growth occurs aboveground, the rhizome becomes depleted of starch until flowering. After flowering, rhizomes elongate and tiller. Then, in late summer, the plants store energy in the rhizome for over-wintering. RCG is biennial with respect to flowering. Like many cool-season perennial grasses, development of flowering stems requires vernalization (a combination of short day photoperiod and cold temperatures). The new stems that develop from seed or rhizome buds require two years to develop panicles. Flowering stems often comprise only about 15% of the total stem density per unit area. In spite of this, seed production in monotypic stands can exceed several hundred seeds per plant, and seed can remain viable in the soil for several years. Seed subject to prolonged inundation, however, can lose viability in as few as 2 years.

Management Considerations

Understanding the adversary is a key for management. Following recommendations from this guide does not guarantee control and/or eradication of RCG. Site-specific conditions and timing variables are likely to influence results. Here are a few important points to remember when considering a management program for this species:

1. RCG is persistent and tenacious due to three of its prolific seed rain and dispersal, robust vegetative growth, and dense network of underground rhizomes with thousands of dormant buds. Therefore, techniques used to suppress above-ground vegetative growth need to be paired with techniques that address the underground rhizomes and seed bank. Neglecting any one component can lead to frustration. Annen (2008) provides a detailed overview of rhizome bud bank persistence and how to incorporate accessory treatments into your management program.

2. RCG often invades native plant communities that are under stress or have been disturbed by past farming practices. When designing a management strategy, be sure to consider the probable cause(s) of the RCG invasion. Underlying conditions such as high nutrient levels in the soil, excessive sedimentation, or off-site factors should be addressed, if feasible, in a site-specific treatment plan.

3. Timing is important, so try to time your treatment to achieve multiple benefits. Mowing, burning or herbiciding with grass-specific chemicals after reed canary grass has achieved some growth in the late spring will reduce or eliminate seed development, allow release of native vegetation to compete with subsequent re-growth, and drain rhizome carbohydrate reserves at a time when they are already being depleted. These same practices applied later in the growing season may be much less effective.

4. Be persistent. Once you start a management effort, do not allow RCG to recover by suspending your management efforts for a growing season. If you are forced to select alternative management measures due to weather conditions, machinery breakdown or other unforeseen obstacles, try to do something to interrupt its growth each year. Generally, you will need to treat the site for a minimum of 3 to 5 years.

5. Sites with diverse vegetation at the onset of management tend to respond more positively to treatments than monotypic stands. The primary goal is to replace RCG with a diversity of native species. If your resources are limited, it may be better to focus management in mixed stands of RCG and native species. Timing management practices to favor an existing native plant community, along with interseeding additional species, can reverse RCG dominance in as little as 2 to 3 years. Once re-established, the native plant community will compete for sunlight, suppressing the RCG seed bank and re-growth from its dormant bud bank. In contrast, formerly cropped sites with few residual native plants or seed often have other invasive species present, have higher management costs, and require more years of treatment to establish a desirable replacement plant community.

6. Finally, practice adaptive management. No one recipe works under all conditions. Keep in mind that the techniques, tools and materials presented here do not include all available management options. Chemical formulations, for instance, are constantly changing, with new products introduced every year. After applying a series of treatments, monitor the plant community response and be willing to change your techniques when conditions favor a different approach. Suppression of RCG may result in other invasive or undesirable species attempting to colonize the site. Learn from your experiences and share them with others.

Remember:

- If using a chemical management technique, be sure to read and follow all labeling instructions. It is a violation of federal law to use an herbicide in a manner inconsistent with its labeling.
- Federal, state and local permits may be required when performing restoration work in wetlands or along waterways. Contact your local DNR office or county zoning administrator before initiating reed canary grass management work.
- It is easy to spread reed canary grass seeds, rhizomes or other plant parts to new locations. Be sure to clean equipment, clothes and footwear before leaving a site.

For more information on reed canary grass, there is a list of resources and readings in the back.
<table>
<thead>
<tr>
<th>TABLE #1 – Management Practices</th>
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<tbody>
<tr>
<td><strong>Treatment</strong></td>
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<td><strong>Burning</strong></td>
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<td><strong>Excavation</strong></td>
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<td><strong>Tree/shrub planting</strong></td>
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<td><strong>Grazing</strong></td>
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<td><strong>Mowing &amp; harvesting (haying)</strong></td>
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<td><strong>Mowing without harvesting</strong></td>
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<td><strong>Herbicide: broad spectrum (i.e. glyphosate, imazapyr)</strong></td>
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<td><strong>Herbicide: grass-specific (i.e. sethoxydim, fluzifop)</strong></td>
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<td><strong>Tillage</strong></td>
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<td><strong>Altering hydrology</strong></td>
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<td><strong>Mulching / solarization with plastic or fabric</strong></td>
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</table>

**RCG= Reed canarygrass**  * For a description of growth stages see the bulletin, Growth and Staging of Wheat, Barley and Wild oat at http://plantsci.missouri.edu/crops/y/growth.html
Guidelines for Planting

**Seeding rates** – Seed bare ground at high rates, 7 to 10 pounds/acre (60 – 100 seeds/ft²) and augment seeding with plugs of five plants where feasible after RCG monocultures have been eliminated. RCG monocultures should also be seeded at this rate after management efforts have significantly weakened RCG resurgence capacity. **Note:** do not rely on a one-time treatment to adequately manage a RCG monotype. Mixed stands can be inter-seeded at a lower rate, 4 to 7 pounds/acre (40 – 60 seeds/ft²), depending on your budget and the density and composition of native species already present. Consider augmenting seedings with live plants (plugs), rhizome fragments (sedges), rooted tubers (emergent plants), or even entire tussocks or sod transplants if a suitable (non-protected) donor site is available. Plugs should also be used in areas prone to erosion where seeds can easily be washed away. When plugging, keep in mind that animal browsing, dry weather, and transplant shock can reduce establishment. You may have to install browsing excluders around plugs and water them regularly during the first growing season. Dip plugs in rooting hormone immediately prior to planting to improve establishment.

**Adaptive Seeding** – Species vary in their planting on a budget, design Species vary in their germination requirements, and site conditions can vary considerably by year. Consider boosting initial high-density plantings with multiple-year seedings at reduced planting densities. This is a way to hedge your bets against adverse conditions during any single growing season, and it will help to re-challenge the native species seed bank. You may also need to adopt a mosaic planting strategy for sites that are still being actively managed during seedling establishment or if bare ground persists.

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**TABLE #2 – Site Assessment**

<table>
<thead>
<tr>
<th>Amount of RCG present</th>
<th>Site characteristics/vegetation (recent &lt;25 year)</th>
<th>Hydrology</th>
<th>Inputs</th>
<th>Tree Planting</th>
<th>Burn*</th>
<th>Excavate**</th>
<th>Gravel</th>
<th>Mow*</th>
<th>Broad-Spectrum Herbicide</th>
<th>Grass- specific Herbicide</th>
<th>Tillage/ Faming</th>
<th>Raise water levels</th>
<th>Seeding*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 25 years since tillage/farming, uniform topography</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
<td>1</td>
<td>1</td>
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<tr>
<td>&gt; 25 years since tillage/farming or no ag history, uneven topography</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
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<tr>
<td>Shrub or forest edge</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
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<tr>
<td>Mixed with non-native grasses and/or weedy forbs</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Mixed with native grasses</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
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<tr>
<td>Mixed with native sedges, rushes and forbs</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
<td>1</td>
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<tr>
<td>Mixed with shrubs or forest matrix</td>
<td>Normally wet/ Seasonally dry</td>
<td>High/Use</td>
<td>1</td>
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</tbody>
</table>

**KEY TO TABLE**

1 = Suitable treatment
2 = May be a suitable treatment, site conditions need to dictate treatment(s) methods
E = Experimental treatment

**Superscripts**

a- Sites with uniform topography lack microtopographic features.

b- Sites with uneven topography possess microtopographic features (sprays, weeps, boulders, tussocks, internal drainage channels, slugs, drowned logs, etc.) and may harbor suppressed native plant communities or remnant native seed banks.

c- Grass specific herbicide should not be applied to open water or areas where standing water is present. Consult herbicide label for application instructions.

**NOTE**

Optimal results will be obtained by using two or more treatments in combination over a period of years, combined with active reseeding of native species. Site conditions should dictate the treatment(s) methods. Always read the herbicide label before application.

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**SPECIES RECOMMENDED FOR REED CANARY GRASS REPLACEMENT**

**Introduction**

Management activities that create bare ground (e.g. removing trees, constructing scrapes, re-contouring wetlands, using nonselective herbicides) should be reseeded quickly, as RCG can rapidly colonize these sites after the disturbance. When reseeding for RCG abatement, your goal should be to create a closed canopy of herbaceous species as quickly as possible, before RCG can re-establish. Research has shown that a closed herbaceous canopy will filter sunlight, increasing the amount of far-red (FR) light reaching the soil surface. As transmittance of far-red light increases (relative to blue light), the percentage of RCG seeds that germinate decreases. Furthermore, RCG displays very low establishment rates and low seedling aggressiveness under light-limited conditions. The ideal endpoint planting, therefore, is one that exhibits a diverse, multi-species herbaceous canopy that is vertically and phenologically layered. The best way to create this is to plant a diverse mixture of different plant shape and forms variable species from different functional guilds (e.g. sedges, rushes, cool- and warm-season grasses, and forbs).

**Purpose of this Species List**

We recommend species that have potential to coexist with RCG in situations where the latter is under stress from management treatment. Proactive re-vegetation with a diversity of native species should be a component of any RCG abatement project. Research has demonstrated that competition from established native species augments and accelerates RCG management efforts. Restoring hydrology, fire regime, etc., is important, but the idea that these will facilitate passive immigration and reestablishment of native vegetation generally lacks empirical support because the present landscape is often too fragmented for adequate gene flow between existing natural areas. The number of RFG seeds that germinate decreases. Furthermore, RCG displays very low establishment rates and low seedling aggressiveness under light-limited conditions. The ideal endpoint planting, therefore, is one that exhibits a diverse, multi-species herbaceous canopy that is vertically and phenologically layered. The best way to create this is to plant a diverse mixture of different plant shape and forms variable species from different functional guilds (e.g. sedges, rushes, cool- and warm-season grasses, and forbs).

**Guidelines for Planting**

**Seeding rates** – Seed bare ground at high rates, 7 to 10 pounds/acre (60 – 100 seeds/ft²) and augment seeding with plugs of five plants where feasible after RCG monocultures have been eliminated. RCG monocultures should also be seeded at this rate after management efforts have significantly weakened RCG resurgence capacity. **Note:** do not rely on a one-time treatment to adequately manage a RCG monotype. Mixed stands can be inter-seeded at a lower rate, 4 to 7 pounds/acre (40 – 60 seeds/ft²), depending on your budget and the density and composition of native species already present. Consider augmenting seedings with live plants (plugs), rhizome fragments (sedges), rooted tubers (emergent plants), or even entire tussocks or sod transplants if a suitable (non-protected) donor site is available. Plugs should also be used in areas prone to erosion where seeds can easily be washed away. When plugging, keep in mind that animal browsing, dry weather, and transplant shock can reduce establishment. You may have to install browsing excluders around plugs and water them regularly during the first growing season. Dip plugs in rooting hormone immediately prior to planting to improve establishment.

**Timing and Site Preparation** – Generally, sowing seed in late fall/winter (frost seeding) favors establishment of most forb sedges, rushes and forbs, cool-season grasses, while spring seeding favors establishment of warm-season grasses. Plugs of most species should be planted in spring to take advantage of wet spring weather and to ensure they have one complete growing season to prepare for overwintering (consult with your local seed distributor if you are unsure of when to plug certain species). To frost seed, one proven method is to burn the site after the first hard frost and broadcast seed onto bare ground. If possible, use a cultipacker to mound the seed onto the soil surface. Subsequent freezing and thawing of the soil will work the seed to proper depth over the winter. An advantage of frost seeding is that seed does not have to be stratified prior to planting. A disadvantage is that weather conducive to stratification cannot be ensured. For sites that have been re-contoured, ask the contractor or agency representative to include microtopographic features. Increasing microtopography will add diversity to the microhabitats available to species and promote canopy connectivity. If feasible, consider installing a passive water control gate to stabilize water levels during plant establishment and to increase long-term management capability.

**Adaptive Seeding** – Species vary in their planting on a budget, design Species vary in their germination requirements, and site conditions can vary considerably by year. Consider boosting initial high-density plantings with multiple-year seedings at reduced planting densities. This is a way to hedge your bets against adverse conditions during any single growing season, and it will help to re-challenge the native species seed bank. You may also need to adopt a mosaic planting strategy for sites that are still being actively managed during seedling establishment or if bare ground persists.

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**Helenium autumnale** is an effective competitor.
Financial Considerations – Costs can vary substantially among local nurseries. Plugs, rootstock, rooted tubers, and rhizome fragments are considerably more expensive than seeds. To achieve a high-diversity planting on a budget, design your seed mix to include one dominant (matrix) species, a few subdominant species and a few species of intermediate abundance, with most species present in rare or uncommon abundance. Try to imitate this natural pattern in your seed mix. This approach reduces costs because the matrix and sub-dominant species are relatively inexpensive while the less common species are often the most expensive. Keep in mind that differing germination requirements of individual species and rapid establishment of aggressive native species (e.g. Panicum virgatum) can make this goal difficult to achieve in a practical setting. If you are on a tight annual budget, one strategy is to spread out costs with consecutive-year reseedings. However, doing this may lead to increased costs for weed control because less space will be occupied by desirable native species. Frank Egler’s “Initial Florigen Composition Model” predicts that the most diverse endpoint community will be the one with the most native propagules present at the outset (bare ground stage). Thus, an ounce of prevention (initial seeding at a high rate) is worth a pound of cure (consecutive years of chemical and mowing costs required to suppress secondary weed outbreaks).

Cool-Season Cover Crops/Companion Crops – Realistically, it will take several years for a native planting to mature to the point of canopy closure. RCG and/or other weeds can quickly re-establish during the interim, particularly if there is off-site impact and propagule influx from adjacent non-treated areas. One way to forestall subsequent infestations (and associated abatement costs) is by planting a rapidly establishing cover crop or companion crop along with your native species mixture. Cover crops are typically annual species (e.g., annual ryegrass (Lolium multiflorum), or beggar-ticks (Bidens sp.)), whereas companion crops are short-lived perennials (e.g., Virginia wild rye (Elymus virginicus) or Canada wild rye (Elymus canadensis)). In theory, cover crops and companion crops reduce competition from weeds while native perennials are establishing. Cover crop seed is available from most native seed nurseries and also from local farm seed suppliers. When purchasing cover crops from local farm seed dealers, be sure to request certified weed-free seed. **NOTE:** do not include cover crop seeding densities when tabulating seeding rates for a planting.

Other Considerations – Sedges of the genera Carex and Scirpus (now called Schoenoplectus, Bokoshoa, or Zanichellia) can be difficult to establish, particularly at sites with flashy or variable hydrology. Consider using a mix of seeds and plugs of these taxa. Alternatively, some sedge species can be propagated from rhizome fragments. Also, recent research has shown that Carex achenes have limited storage life. Sow Carex seeds in the same growing season you collect them, or, if ordering seeds from a nursery, inquire about the collection date for the seed lot you are ordering. For sites with variable hydrology, consider planting species that are adapted to grow in more than one hydrologic regime or species with plastic morphological responses to water level variations (e.g. Polygonum amphibium) so that RCG cannot take advantage of fluctuating water level disturbances to recolonize a site. When collecting seed, remember to increase your seeding rate (by at least 50%) because site-collected seed typically has a lower germination rate (lower titer or PLS-pure live seed) than nursery seed. Use of PLS seed in plantings has been shown to make a big difference in germination of desired endpoint species. If not used immediately, store any seed in a cool, dry location that is not exposed to direct sunlight or extreme temperature fluctuations. Plugs, sprigs, or live plants should be set out as soon as possible. If this is not possible, store in damp peat moss or sand in a cool location away from direct sunlight or follow instructions and recommendations from the supplier. Try to collect or purchase seeds from source populations that are located as close to the planting site as possible. Most seed nurseries keep records of seed genotype and label their seed lots with this information. If your goal is not ecological restoration of a native plant community, contact your local USDA-Natural Resources Conservation Service for alternative seeding options.

GUIDELINES FOR USING TABLE 3 TO CUSTOMIZE SEED MIXTURES

- Phenology mix (5 early species, 5 mid, 5 late season time of peak productivity).
- Use a low Graminoid/Forb ratio (1:4 or lower) to maximize canopy closure.
- Use a minimum of three late successional species.
- Use a minimum of 15 species (50% early successional, 25% mid successional, and 25% late successional).
- A complex canopy with mixed height and variable leaf morphology should be implicit in seed designs.
- Consider cool season and early emerging annual species to accelerate canopy closure and provide competition for seedling RCG.
- For woody species, employ protective shelters and tall, mature stock. Consider a tree-planting mix that includes evergreens to provide early and late-season shade.

Key

- **Species ranking:** 1 = highly recommended/high importance; 2 = moderate importance; 3 = low importance or importance unknown.
- **Phenology:** Early (April – May peak productivity), Mid (June – mid July peak productivity), Late (mid July – September peak productivity).
- **Trees:** Trees should be taller than RCG, 1” minimum dbh is recommended. Use of a weed barrier and deer/rodent protection is also recommended.
- **Successional Stage:** Early (25-50% bare ground, many weedy or short-lived species present), Mid (10-25% bare ground, a few species often dominate), Late (0-10% bare ground, many conservative species are present, plant community is stable with few canopy gaps).
- **Hydrology**

**Mesic plant community type:**
Deep, well-drained to moderately well-drained soils with moderate permeability and high available water capacity. These are typically mineral soils with no equipment limitations throughout the growing season.

**Wet-mesic plant community type:**
Deep, somewhat poorly-drained soils with moderately slow permeability and a seasonal high water table to within 1 ft of the surface for part of the growing season. Soils are mineral or shallow organic with moderate equipment limitations during the growing season.

**Wet plant community type:**
Deep poorly-drained to somewhat poorly-drained soils with slow permeability and a seasonal high water table at or near the surface for much of the growing season. Soils can be mineral or deep organic with severe equipment limitations for most of the growing season.
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### Table #3b – Tree and shrub species recommended for reed canary grass replacement

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<tr>
<th>Latin name</th>
<th>Common name</th>
<th>Species Preferred Ranking</th>
<th>Phenology</th>
<th>Hydrology</th>
<th>Geographic Area</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Abies balsamea</td>
<td>Balsam fir</td>
<td>1</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>statewide</td>
<td>not preferred deer food</td>
</tr>
<tr>
<td>Acer rubrum</td>
<td>Red maple</td>
<td>2</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>statewide</td>
<td>Slow-growing, mineral soils</td>
</tr>
<tr>
<td>Acer saccharinum</td>
<td>Silver maple</td>
<td>1</td>
<td>early-late</td>
<td>flood tolerant</td>
<td>more common south</td>
<td>Fast-growing, weak limbs, mineral soils</td>
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<tr>
<td>Alnus incana subsp. rugosa</td>
<td>Speckled alder</td>
<td>1</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>statewide but more common north</td>
<td>Invasive to uplands</td>
</tr>
<tr>
<td>Cephalanthus occidentalis</td>
<td>Buttonbush</td>
<td>2</td>
<td>early</td>
<td>wet/wet mesic</td>
<td>more common south</td>
<td>Can grow in shallow water</td>
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<tr>
<td>Cornus amomum</td>
<td>Stiff dogwood</td>
<td>1</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>statewide</td>
<td>Browsed heavily by deer</td>
</tr>
<tr>
<td>Cornus racemosa</td>
<td>Grey dogwood</td>
<td>2</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>more common south</td>
<td>Mineral soils, can be invasive</td>
</tr>
<tr>
<td>Cornus stolonifera</td>
<td>Red-osier dogwood</td>
<td>1</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>statewide</td>
<td>Browed heavily by deer</td>
</tr>
<tr>
<td>Fraxinus nigra</td>
<td>Black ash</td>
<td>3</td>
<td>early-late</td>
<td>flood tolerant</td>
<td>more common north</td>
<td>Emerald ash borer concern keep &lt;10% of trees planted. Better for wet sites.</td>
</tr>
<tr>
<td>Fraxinus pennsylvanica</td>
<td>Green ash</td>
<td>2</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>statewide</td>
<td>Emerald ash borer concern keep &lt;10% of trees planted</td>
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<tr>
<td>Ilex verticillata</td>
<td>Winterberry</td>
<td>1</td>
<td>late</td>
<td>wet/wet mesic</td>
<td>more common north</td>
<td>Good for songbirds, prefers sandy/loamy soils</td>
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<td>Tamarack</td>
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<td>early-mid</td>
<td>wet/wet mesic</td>
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<td>Browsed heavily by deer</td>
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<tr>
<td>Physocarpus opulifolius</td>
<td>Common ninebark</td>
<td>1</td>
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<td>wet mesic/mesic</td>
<td>more common south</td>
<td>Somewhat drier sites, mineral soils</td>
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<tr>
<td>Populus balsamifera</td>
<td>Balsam poplar</td>
<td>1</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>northern</td>
<td>Not preferred deer food</td>
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<tr>
<td>Populus cyanescens</td>
<td>Grey cottonwood</td>
<td>2</td>
<td>early-mid</td>
<td>wet/wet mesic</td>
<td>more common south</td>
<td>Somewhat drier sites, mineral soils</td>
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<td>Populus deltoides</td>
<td>Cottonwood</td>
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<td>early-mid</td>
<td>flood tolerant</td>
<td>statewide</td>
<td>Invasive to uplands</td>
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<td>Populus grandidentata</td>
<td>Bigtooth aspen</td>
<td>1</td>
<td>early-mid</td>
<td>wet mesic/mesic</td>
<td>statewide</td>
<td>Somewhat drier sites, invasive to uplands</td>
</tr>
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<td>Quaking aspen</td>
<td>2</td>
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<td>wet mesic/mesic</td>
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<td>Invasive to uplands</td>
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<tr>
<td>Quercus bicolor</td>
<td>Swamp white oak</td>
<td>1</td>
<td>late</td>
<td>wet mesic/mesic</td>
<td>southern</td>
<td>Somewhat flood tolerant (short duration flooding)</td>
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<td>Native buckthorn</td>
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<td>late</td>
<td>wet mesic/mesic</td>
<td>Door County, north</td>
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<td>Ribes americanum</td>
<td>Black currant</td>
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<td>flood tolerant</td>
<td>statewide</td>
<td>Shade tolerant shrub</td>
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<td>Salix nigra</td>
<td>Black willow</td>
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<td>wet/wet mesic</td>
<td>statewide</td>
<td>Some species can be invasive, especially s exigua</td>
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<td>Willow (Bebb's, pussy, sandbar)</td>
<td>1</td>
<td>mid</td>
<td>late</td>
<td>wet mesic/mesic</td>
<td>Statewide</td>
</tr>
<tr>
<td>Spiraea alba/tomentosa</td>
<td>Meadow sweet</td>
<td>2</td>
<td>mid</td>
<td>late</td>
<td>mesic-mesic</td>
<td>Door County, north</td>
</tr>
<tr>
<td>Viburnum lentago</td>
<td>Nannyberry</td>
<td>1</td>
<td>mid</td>
<td>late</td>
<td>mesic/mesic</td>
<td>more common south</td>
</tr>
<tr>
<td>Viburnum opulus subsp. fruticosum</td>
<td>High bush cranberry</td>
<td>2</td>
<td>mid</td>
<td>late</td>
<td>mesic/mesic</td>
<td>statewide</td>
</tr>
</tbody>
</table>

Following are examples of 15-species seed mixes. You may want to add or substitute additional species to your mix to compensate for changes in hydrology, climate and other site conditions affecting seed germination.

<table>
<thead>
<tr>
<th>Wet Meadow 1</th>
<th>Wet Meadow 2</th>
<th>Sedge Meadow</th>
<th>Low Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asclepias incarnata</td>
<td>Asclepias incarnata</td>
<td>Asclepias incarnata</td>
<td>Acer saccharinum</td>
</tr>
<tr>
<td>Aster puniceus</td>
<td>Bidens cernua</td>
<td>Aster firmus</td>
<td>Calamagrostis canadensis</td>
</tr>
<tr>
<td>Bidens frondosa</td>
<td>Calamagrostis canadensis</td>
<td>Bidens frondosa</td>
<td>Carex comosa</td>
</tr>
<tr>
<td>Calamagrostis canadensis</td>
<td>Carex stricta</td>
<td>Calamagrostis canadensis</td>
<td>Carex lacustris</td>
</tr>
<tr>
<td>Carex scoparia</td>
<td>Carex vulpinoidea</td>
<td>Carex comosa</td>
<td>Carex vulpinoidea</td>
</tr>
<tr>
<td>Carex stipata</td>
<td>Cicutta maculate</td>
<td>Carex lacustris</td>
<td>Carex comosa</td>
</tr>
<tr>
<td>Cicutta maculate</td>
<td>Echinocloa crus-galli</td>
<td>Carex stricta</td>
<td>Cinna latifolia</td>
</tr>
<tr>
<td>Elymus canadensis</td>
<td>Elymus virginicus</td>
<td>Carex vulpinoidea</td>
<td>Carex comosa</td>
</tr>
<tr>
<td>Eupatorium maculatum</td>
<td>Eupatorium perfoliatum</td>
<td>Elymus virginicus</td>
<td>Eupatorium perfoliatum</td>
</tr>
<tr>
<td>Helianthus giganteus</td>
<td>Glyceria grandis</td>
<td>Eupatorium maculatum</td>
<td>Fraxinus nigra</td>
</tr>
<tr>
<td>Leersia oryzoides</td>
<td>Heliamnumu autumnale</td>
<td>Impatients capensis</td>
<td>Muhlenbergia mexicana</td>
</tr>
<tr>
<td>Rudbeckia hirta</td>
<td>Monarda fistulosa</td>
<td>Juncus effusus</td>
<td>Populus tremuloides</td>
</tr>
<tr>
<td>Scirpus cyperinus</td>
<td>Ratibida pinnata</td>
<td>Pycnanthemum virginianum</td>
<td>Rudbeckia laciniata</td>
</tr>
<tr>
<td>Solidago gigantea</td>
<td>Scirpus atrovirens</td>
<td>Rudbeckia laciniata</td>
<td>Scirpus cyperinus</td>
</tr>
<tr>
<td>Spartina pectinata</td>
<td>Verbena hastata</td>
<td>Scirpus cyperinus</td>
<td>Viburnum lentago</td>
</tr>
</tbody>
</table>

**Notes:**
- **Wet Meadow 1** — Meets all environmental conditions with the exception of being used in species mixtures that require a more open canopy.
- **Wet Meadow 2** — High tolerance to shade and wet soils.
- **Sedge Meadow** — Small, random clumps of grasses in low light conditions.
- **Low Forest** — Species that are typically used in forested areas or those that prefer drier conditions.
For Further Reading:

References: